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EFFECT OF "PASSIVE" SMOKING ON THE PHYSICAL LOAD TOLERANCE OF CORONARY HEART DISEASE PATIENTS

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Summary

"Passive" smoking has been shown to produce a marked negative effect on CHD patients. Short-term airing of a room does not prevent a negative effect of "passive" smoking.

Translated from Russian

EFFECT OF "PASSIVE" SMOKING ON THE PHYSICAL LOAD TOLERANCE OF CORONARY HEART DISEASE PATIENTS

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There is no doubt at the present time that smoking can promote the development of coronary heart disease (CHD) [1,2,4,5]. The risk of CHD is doubled or tripled in people who smoke more than one pack of cigarettes per day [3,10]. The incidence of a myocardial infarction and sudden death has been linked directly to smoking [5,7]. Furthermore, the risk of a second myocardial infarction and sudden death is reduced 20 to 50% [11,12] if the smoker stops smoking.

A negative correlation between cigarette smoking and tolerance to physical load has been found in bicycle ergometry tests [1]. A spasm confirmed by coronary angiography in the coronary arteries and intensification of thrombocyte aggregation have been linked with smoking [9].

However, the overwhelming majority of investigations have been carried out on smokers. Nevertheless, it has been shown [8,11] that even "passive" smoking, i.e., just being present in a smoky environment and breathing tobacco, has a strong negative effect on the state of the cardiovascular system. D. Makkenzi [8] believes that about a thousand English people die every year from the effects of "passive" smoking.

"Passive" smoking has not yet been investigated adequately. We have therefore performed a study aimed at evaluating the effect of "passive" smoking on the indices obtained in the bicycle ergometer test on CHD patients.

We made observations on 81 people, 10 of whom were practically healthy and ranged from 25 to 48 years of age (average age 38) and 71 patients with angina of effort ranging from 31 to 63 years (average age 49). All the subjects were men.

The angina patients included 33 smokers (who smoked an average of one pack of cigarettes per day) and 38 nonsmokers. The healthy group included 5 smokers and 5 nonsmokers.

Thirty-nine CHD patients had functional class I and II angina of effort and 32 had class III and IV angina of effort. Fifteen had undergone a transmural myocardial infarction in the past and 10 suffered from stage II hypertensive disease.

All the smokers abstained from smoking for two hours before taking the bicycle ergometer test. All the patients refrained from using antianginal agents several days before the tests, except for nitroglycerine tablets.

The bicycle ergometer test was carried out with the subjects in a sitting position on a Simens-Elema bicycle ergometer, registering the EKG with three Nebo leads on a Mingography-82 current polygraph. A continuous load was employed lasting 3 minutes, increasing by consecutive steps of 25 W. The bicycle ergometer test was stopped when a submaximum pulse rate was reached, when the ST segment shifted horizontally or slanting downward 1 mm or more below the isolines, when a typical angina attack occurred, which was arrested by administration of nitroglycerine, or when the T wave was inverted in two or more of the traces.

In evaluating the bicycle ergometer test, we considered the

following indices: tolerance to load (in Watts), the double product of DP (in arbitrary units) and the ratio of the DP to the power load (DP/W).

The bicycle ergometer was installed and the test conducted in a 24-m^2 room, 3.2 m high. The test was performed on the subjects at first under the usual conditions in accordance with the procedure described above. Then eight cigarettes were smoked in the room over a two-hour period (one cigarette every 15 minutes). The subjects were in the room for this entire period, sitting in a chair, reading magazines, talking, or playing checkers. A second bicycle ergometer test was performed after this two-hour period in the smoky room.

The test was modified for 15 of the subjects by ventilating the smoky room for 10 minutes through a 0.5-m^2 transome twice during their two-hour stay (at the end of each hour).

In order to determine whether or not the first bicycle ergometer test affected the indices of the second test two hours later, tolerance to load tests were made on class II and IV angina of effort patients (average age 48) twice, two hours apart, after they had been in the room described above but without any smoke. The original tolerance to load averaged 62.5 $\pm$ 1.4 W and tolerance in the second test after two hours was 70 $\pm$ 2.0 W (three angina of effort patients showed tolerances in the second test that were one step higher, by 25 W).

The tests confirmed the validity of using paired bicycle ergometer loads. The validity of such a test has been demonstrated by extensive experience in our country and abroad in grading patients who take antianginal preparations.

The tests have shown that the tolerance to load in a group of practically healthy people before a stay in a smoky room averaged 192 ± 5.5 W, DP averaged 246 ± 7.2 arbitrary units, and the DP/W index was 1.3 ± 0.04. After "passive" smoking, the tolerance to load in this group was 197 ± 5.7 W, DP was 238 ± 7.1 arbitrary units, and DP/W was 1.2 ± 0.03. Thus, there were no statistically significant differences in the bicycle ergometer indices in healthy people and after "passive" smoking.

We made a separate analysis of the results of the "passive" smoking test in the CHD patients without room ventilation (Group 1) and in those with a short period of ventilation (Group 2).

The average tolerance to load in the Group 1 angina of effort patients was 87 ± 2.6 W before the "passive" smoking test in the unventilated room and 63 ± 1.8 W after the test ($p < 0.01$). The main reasons for stopping the bicycle ergometer test both before and after smoking were an attack of angina of effort in 21 people, a shift in the ST segment 1 mm or more below the isoline in 18, inversion of the T waves in four, and achieving a submaximal heart contraction rate in three.

"Passive" smoking in angina of effort patients results in a lower tolerance to load, a lower DP and a higher DP/W ratio (Table 1). These changes were much more pronounced in class III and IV angina of effort patients than in class I and II angina patients. Thus, smokers who were class I and II angina of effort patients showed a 17% decrease in tolerance to load, whereas class III and IV angina patients showed a decrease of 47%.

TABLE 1. Bicyle ergometer test indices in patients with angina of effort: A) before the 2-hour stay in the unventilated smoke-filled room; B) after the 2-hour stay (M±m).

Functional class of angina of effort	Index	Nonsmokers			Smokers		
		A	B	P	A	B	P
I—II	Tolerance to load, W	109±3.9	90±2.8	<0.01	125±3.8	116±3.5	<0.05
	DP, arbit. *units	194±5.7	182±5.5	>0.05	183±5.4	177±5.3	>0.05
	DP/W	1.8±0.06	2.0±0.06	>0.05	1.5±0.05	1.5±0.05	>0.05
III—IV	Tolerance to load, W	57±1.6	30±1.0	<0.01	50±1.5	28±0.8	<0.01
	DP, arbit. units	148±4.3	126±3.6	<0.01	129±3.5	115±3.5	<0.01
	DP/W	2.6±0.07	4.2±0.1	<0.01	2.6±0.07	4.0±0.09	<0.01

*arbitrary units

The tolerance to physical load and the DP after staying in the smoky room dropped distinctly whether or not the patient was a smoker. However, the drop in bicycle ergometer indices induced by "passive" smoking was somewhat lower in smokers than in nonsmokers. It should be pointed out that such a difference was detected in patients with more moderate angina of effort, whereas class III and IV angina of effort patients reacted almost identically to "passive" smoking whether they were smokers or not.

Patient E. Age 47. Diagnosis: CHD, functional class III angina of effort. Pressing chest pains radiating to the left shoulder appeared daily when walking or ascending a stairway. Pains lasted 2 to 3 minutes after he stopped moving or took nitroglycerine. The coronary angiography indicated 90% stenosis of the right coronary artery and 50% stenosis of the circumflex branch of the left coronary artery. A bicycle ergometer test was performed on June 27, 1985. No pathological changes in the EKG were detected at rest before the ergometer test.

The bicycle ergometer test before "passive" smoking gave a tolerance to load of 75 W, a DP of 220 arbitrary units, and a DP/W ratio of 2.9. The test was stopped because of an angina attack and a shift of the ST segment 1 mm below the isolines on two traces (see Figure 1).

A second ergometer test was performed after he had spent two hours in the smoke-filled room. This time tolerance to load was 50 W, DP 200 arbitrary units, and DP/W 4.0. The test was stopped because of an angina attack and a shift in the ST segment 1.5 mm below the isolines on the two traces.

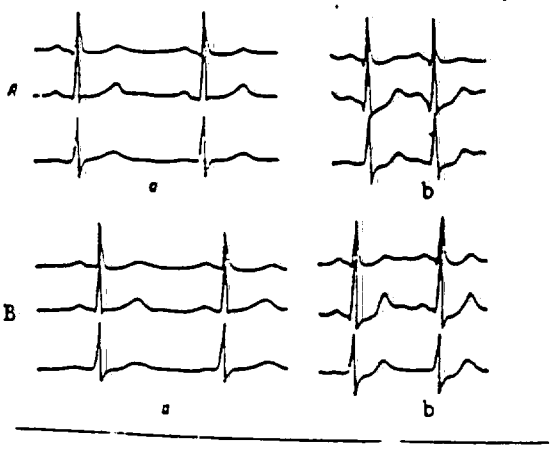

Figure 1. Dynamics of the EKG in patient E, age 47, during bicycle ergometer test: A) before 2-hour stay in unventilated smoke-filled room; B) after the 2-two stay. a) EKG at rest; b) EKG during the bicycle ergometer test. Explanation in text.

Thus, load tolerance dropped, DP decreased, and DP/W increased in a patient suffering from class III angina of effort after "passive" smoking.

When the test was conducted by ventilating the room for a short time during the "passive" smoking period, the load tolerance of group 2 angina patients was 89 $\pm$ 2.5 W before "passive" smoking and 63 $\pm$ 1.7 W thereafter ($p < 0.01$). The bicycle ergometer tests were stopped because of an attack of angina of effort in 7 patients, followed by nitroglycerine administration; because of a shift in the ST segment 1 mm below the isolines in 6; and because of inversion of the T wave in 2.

A marked decrease in load tolerance and DP and an increase in DP/W were found in the patients. Two 10-minute ventilation periods in two hours did not prevent the effect of "passive" smoking (Table 2).

The rather large room used in this study was not very smoky, since only 8 cigarettes were smoked in two hours. In reality, we often encounter a much higher concentration of tobacco smoke in rooms. However, "passive" smoking in a room with a relatively low smoke concentration had a pronounced negative effect on all the subjects who were CHD patients, lowering tolerance to physical load, decreasing DP, and raising the DP/W ratio. A short ventilation period through a transom (which is usually typical of residential and service rooms) did not prevent "passive" smoking from exerting its effect.

TABLE 2. Bicycle ergometer test indices in patients with angina of effort: A) before 2-hour stay in smoke-filled room ventilated for short time; B) after the 2-hour stay (M±m).

Functional class of angina of effort	Index	Nonsmokers			Smokers		
		A	B	p	A	B	p
I—II	Tolerance to load, W	120±3.3	105±3.1	<0.01	113±3.5	110±3.3	>0.05
	DP, arbit. units	196±5.7	183±5.5	>0.05	190±5.4	188±5.2	>0.05
	DP/W	1.6±0.05	1.8±0.06	>0.05	1.7±0.06	1.9±0.06	>0.05
III—IV	Tolerance to load, W	50±1.4	25±0.7	<0.01	50±1.4	25±0.8	<0.01
	DP, arbit. units	143±4.2	118±3.6	<0.01	137±3.4	110±2.9	<0.01
	DP/W	2.9±0.08	4.7±0.1	<0.01	2.8±0.07	4.0±0.09	<0.01

References.

1. Oleinikov, S.P. Byul. Vsesoyuz. kardiol. nauch. tsentra., 1983, No. 1, p. 115-119.

2. Chazov, E.I., Ed. "Handbook of Cardiology." Vol. 3, Moscow, 1982.

3. Khalfen, E.Sh. "Ischaemic Heart Disease." Moscow, 1972.

4. Khalfen, E.Sh. Kardiologiya, 1983, No. 1, p. 19-26.

5. Coronary Drug Project Research Group J. Chron. Dis., 1979, 32, p. 415-425.

6. Erikssen, J., Enger, S.C. Acta Med. Scand., 1978, 203, p. 509-516.

7. Libow, M., Schlante, R. Inform. Cardiol., 1983, 7, p. 825-847.

8. Makkenzi, D. New Sci., 1985, 105, p. 14.

9. Maouad, J., Fernandez, T., Barrilon, A., et al. Amer J. Cardiol., 1984, 53, p. 354-355.

10. Nora, J.J. "Preventive Cardiology." London, 1984, p. 123-144.

11. O'Neal, D., Humphries, J., Julian, D. "Preventive Cardiology." London, 1984, p. 145-164.

12. Schettler, G., Rose, G., Konig, K. Clin. Cardiol., 1981, 4, p. 112-116.